Canadian Nuclear Society
Société Nucléaire Canadienne

4th CNS International

Steam Generator Conference

Program
May 5 - 8, 2002

Toronto, Ontario, Canada
Marriott Eaton Centre Hotel

Sunday, May 5

1700 Registration

1800 Reception
Trinity Ballroom, Salon 1 and 2

Day 1: Monday, May 6

0700 Speaker's Breakfast

0800 Opening Address
P. Spekkens, Vice-President – Special Projects, Ontario Power Generation
Grand Ballroom, Salon A and B

0810 Plenary Lecture
Plenary Lecturer: J. Muscara, US NRC
Research Perspectives on the Evaluation of Steam Generator Tube Integrity, J. Muscara (US NRC), D.R. Diercks, S. Majumdar, D.S. Kupperman, S. Bakhtiari and W.J. Shack (Argonne National Laboratory); Grand Ballroom, Salon A and B

0900 Session 1
Life Management Strategies, Replacement Strategies, and Regulatory Issues
Co-Chairs: R.L. Tapping, AECL
K.S. Lee, KEPRI
Grand Ballroom, Salon A and B

1200 Conference Luncheon
Grand Ballroom, Salon C and D

1330 Session 2
Operational Experience
Co-Chairs: C. Daniel, Ontario Power Generation and S. Odar, Framatome ANP
Grand Ballroom, Salon A and B

1745 Session 3
Poster Session
Organizer: G. Wolgemuth, AECL
Grand Ballroom, Salon A and B

Day 2: Tuesday, May 7

0700 Speaker's Breakfast

0830 Session 4
Vibration, Fretting and Fatigue
Co-Chairs: C. Taylor, AECL
E.G. Price, AECL (Retired)
Grand Ballroom, Salon A and B

1200 Conference Luncheon
Grand Ballroom, Salon C and D

1330 Session 5
Thermalhydraulics, Fouling and Cleaning
Co-Chairs: P. King, B&W Canada
R.W. Staehle, U of Minnesota
Grand Ballroom, Salon A and B

1700 Babcock & Wilcox Plant Tour
Babcock & Wilcox hosted a tour of its plant at Cambridge, Ontario on Tuesday, May 7, 2002. This facility engineers and manufactures steam generators and heat exchangers for CANDU and PWR nuclear plants as well as boilers for fossil utility and fossil industrial applications. Fabrication of replacement steam generators for several plants is now in progress. The tour also included dinner at a restaurant in the Cambridge area.

Day 3: Wednesday, May 8

0700 Speaker's Breakfast

0830 Session 6
Inspection Advancements and Experience and Fitness for Service
Co-Chairs:
W. Schneider, B&W Canada
J. Muscara, US NRC
Grand Ballroom, Salon A and B

1200 Conference Luncheon
Grand Ballroom, Salon C and D

1330 Session 7
Materials, Corrosion and Chemistry Control
Co-Chairs:
A.M. Brennenstuhl, Kinetrics Inc.
T. Cicerone, CNE-PROD Cernavoda
Grand Ballroom, Salon A and B

1630 Closing Remarks
Conference Chair:
M. Léger, AECL
Grand Ballroom, Salon A and B

1700 Conference Closing

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4TH CNS INTERNATIONAL
STEAM GENERATOR CONFERENCE

INTRODUCTION TO THE PROCEEDINGS

R.L. Tapping, AECL, Chair, Program Technical Committee

FOREWORD

M. Léger, AECL, Chair, Conference Organizing Committee

OPENING ADDRESS

P. Spekkens, Vice-President, Special Projects, Ontario Power Generation

PLENARY LECTURE

Plenary Lecturer: J. Muscara, US NRC;
Research Perspectives on the Evaluation of Steam Generator Tube Integrity, J. Muscara,US NRC, D.R. Diercks, S. Majumdar, D.S. Kupperman, S. Bakhtiari and W.J. Shack, Argonne National Laboratory

Session 1
Life Management Strategies, Replacement Strategies, and Regulatory Issues

Co-Chairs: ***R.L.Tapping, AECL***
K.S. Lee, KEPRI

#1-1 **IAEA Activities on Steam Generator Life Management,** B. Gueorguiev, V. Lyssakov and P. Trampus, International Atomic Energy Agency

#1-2 **Regulation of Steam Generators in Canada,** A. Ibrahim, W. Spekkens, I. Malek, I. Grant, J. Blyth and J.B. Riznic, CNSC

#1-3 **Life Extension, Power Upgrade, and Return to Service Work for Pickering NGS A and Other PWR and CANDU Plants,** J. Millman, N. Idvorian and W. Schneider, B&W Canada

#1-4 **Strategic Maintenance Plan for CernavodaSteam Generators,** T. Cicerone, CNE-PROD Cernavoda, D. Dhar and J.P. VandenBerg, B&W Canada

#1-5 **Replacement Steam Generators for Calvert Cliffs,Oconee and Future Replacement Design,** R. Klarner, S. Fluit and W. Schneider, B&W Canada

Session 2
Operational Experience

Co-Chairs: ***C. Daniel, Ontario Power Generation***
S. Odar, Framatome ANP

#2-1 **Short Steam Generator Outages–World-wide Experience,** E.F. Ivins and K. Burch, Framatome ANP Inc.

#2-2 **Wolf Creek Feedwater Heater Repair,** S.Wahlmeier, Wolf Creek Nuclear Operating Co. and B.W. Schafer, Framatome ANP Inc.

#2-3 **Characterization of Plastic Strains and Crystallographic Properties Surrounding Defects in Steam Generator Tubes by Orientation Imaging Microscopy,** E.M. Lehockey and A.M. Brennenstuhl, Kinectrics Inc.

#2-4 **Steam Generator Life Cycle Management–Ontario Power Generation Experience,** C.C. Maruska, Ontario Power Generation

Session 2
Operational Experience continued...

Co-Chairs: ***C. Daniel, Ontario Power Generation***
S. Odar, Framatome ANP

#2-5 **Distribution of Impurities in Dukovany and Mochovce Steam Generators Secondary Water,** L. Papp, NRI Rez

#2-6 **Status of Hide Out Return Test in Korean Nuclear Steam Generators,** H.S. Chung, H.D. Kim and K.S. Choi, KEPRI
(not presented)

#2-7 **Steam Generators: Some Water Chemistry and Deposits Characterization Data,** M. Chocron [1], A.N. Fernandez [2], A.M. La Gamma [1], L Ovando [2], R. Servant [1] and M. Villegas [1], [1] Comision Nacional de Energia Atomica, [2] Central Nuclear Embalse, Nucleoelectrica Argentina S.A.
(not presented)

Session 3
Poster Session

Organizer: ***G. Wolgemuth, AECL***

#3-1 **Computer-aided Multi-frequency Analysis of Eddy CurrentRotating Probe Data,** S. Bakhtiari, J.Y. Park, D.S. Kupperman and W.J. Shack, Argonne National Laboratory

#3-2 **Computer-assisted Multi-frequency Analysis of Array Probe Data,** D. Horn, AECL, Chalk River Laboratories

#3-3 **Ontario Power Generation's Steam Generator Tube Testing Project,** M.J. Kozluk, Kinectrics Inc., D.G. Martin, formerly with Ontario Power Generation and B.E. Mills, Kinectrics Inc.

#3-4 **Boiling Heat Transfer Coefficients under CANDU Steam Generator Conditions,** J.M. Pietralik, S.J. Klimas and M. Yetisir, AECL, Chalk River Laboratories

Session 3
Poster Session continued...

Organizer: ***G. Wolgemuth, AECL***

#3-5 **An Advanced Thermalhydraulic Model for a U-tube Steam Generator,** R. Yu, Point Lepreau Generating Station, NB Power

#3-6 **Vibration and Work Rate Measurements of Steam Generator U-tubes in Air-Water Cross Flow,** V.P. Janzen, E.G. Hagberg, T.G. Whan, and J. Patrick, AECL, Chalk River Laboratories

#3-7 **Fretting-wear of Steam Generator Tubes in Room Temperature Water**, Y.-Ho Lee and I.-S. Kim, KAIST

#3-8 **A Verification and Validation Study of Vibration Prediction Codes–PIPO-FE and VIBIC,** Y. Han and N.J. Fisher, AECL, Chalk River Laboratories

Session 3
Poster Session continued...

Organizer: ***G. Wolgemuth, AECL***

#3-9 **Darlington NGS Steam Generator Tube Fretting at Anti-vibration Bar/U-bend Supports–Acceptance Criteria,** M. Mirzai, E.E. Cartar and D.B. Paras, Ontario Power Generation

#3-10 **Hideout Return Surveys Conducted at Ontario Power Generation Nuclear Plants,** A. McKay, Ontario Power Generation

#3-11 **The Effect of Hydrazine on the Corrosion Response of a Steam Generator Tubesheet/UNS N06600 Galvanic Couple During Startup,** A.M. Brennenstuhl, Kinectrics Inc., S. Ramamurthy, U of Western Ontario and A. McBride, Kinectrics Inc.

#3-12 This paper was cancelled.

#3-13 **Oconee 1, 2 and 3 Replacement Once Through Steam Generators,** R. Klarner, T. Boyd, B&W Canada and M. Keck, Duke Power Corp.

Session 3
Poster Session continued...

Organizer: ***G. Wolgemuth, AECL***

#3-14 **Development of Pitting Models to Aid Steam Generator Life Management,** P. Angell, AECL, Chalk River Laboratories

#3-15 **Microstructure and Microchemistry of Steam Generator Tubing,** V. Perovic, Kinectrics Inc., A Perovic, G.C. Weatherly, McMaster University and A.M. Brennenstuhl, Kinectrics Inc.

#3-16 **Enhanced Nuclear Steam Generator and Related Component Reliability by Application of Interfacial Materials Technologies,** G. Palumbo, P. Lin, F. Gonzalez, Integran Technologies, D. Lee and C. Mackenzie, B&W Canada

#3-17 **The Effect of Galvanic Coupling on the Tubesheet/ Mid-span and Tube Support Underdeposit Corrosion of UNS N04400 CANDU Steam Generator Tube Material,** A.M. Brennenstuhl, A. McBride, Kinectrics Inc., S. Ramamurthy and J.T. Francis, U of Western Ontario

Session 3
Poster Session continued...

Organizer: ***G. Wolgemuth, AECL***

#3-18 **Electrochemical Aspects of Defining the Safe Potential/pH Zone for Corrosion Prevention of Alloy 800 Steam Generator Tubing,** Y.C. Lu, AECL, Chalk River Laboratories

#3-19 **Short Intergranular Cracks Between Randomly Oriented Anisotropically-elastic Grains,** L. Cizelj, "Jozef Stefan" Institute, Reactor Engineering Division andI. Kovse, Institute of Metal Constructions, Slovenia

#3-20 **The Study of the Impurities Concentration Processes Into CANDU Steam Generator Crevices,** D. Lucan, M. Fulger, Institute for Nuclear Research, Pitesi,A. Woinaroschy and G. Jinescu, Politehnica University of Bucharest

#3-21 **Flow-accelerated Corrosion (FAC) Testing of Carbon and Low Alloy Steels in Nuclear Steam Generator Environments,** P.J. King, B&W Canada, F.H. Hua, J.M. Jevec and R.H. Pelger, McDermott Technology Inc.

Session 4
Vibration, Fretting and Fatigue

Co-Chairs: ***C. Taylor, AECL***
E. G. Price, AECL (Retired)

#4-1 **Steam Generator Tube Fretting Experience,** W. Schneider and S. Fluit, B&W Canada

#4-2 **A Simple Energy Approach to Assess Fretting-wear Damage,** M. Pettigrew, École Polytechnique de Montréal, B&W Canada/AECL/NSERC Chair of Fluid-Structure Interaction and M. Yetisir, AECL, Chalk River Laboratories

#4-3 **Monte Carlo Simulation of Fretting Wear in Steam Generator Tubes Under Flow Induced Vibration,** G.D. Morandin and R.G. Sauvé, Kinectrics Inc.

#4-4 **Wear Behaviour of Steam Generator Tubes in High Temperature Water Environment,** J.-K. Hong and I.-S. Kim, KAIST

Session 4
Vibration, Fretting and Fatigue continued...

Co-Chairs: *C. Taylor, AECL*
E. G. Price, AECL (Retired)

#4-5 **Steam Generator Tube Fretting – Darlington NGS Experience,** M. Mirzai and D.B. Paras, Ontario Power Generation

#4-6 **Vibration and Fretting-wear Methodology to Predict Component Remaining Life,** N.J. Fisher, Y. Han, V.P. Janzen and V.S. Cecco, AECL, Chalk River Laboratories

Session 5
Thermalhydraulics, Fouling and Cleaning

Co-Chairs: ***P.J. King, B&W Canada***
R.W. Staehle, U of Minnesota

#5-1 **New Insights into Controlling Tube-bundle Fouling Using Alternative Amines,** C.W. Turner, S.J. Klimas, D.A. Guzonas, AECL, Chalk River Laboratories, P.L. Frattini and K. Fruzzetti, EPRI

#5-2 **Two-phase Forced-convective Fouling under Steam Generator Operating Conditions,** S.J. Klimas and M. Pietralik, AECL, Chalk River Laboratories

#5-3 **Evaluation of the Flow Around the Tube Support Plate and Its Effect on Scale Deposition,** K. Yoneda, A. Yasuo, F. Inada and M. Furuya, CRIEPI

#5-4 **Research Program of Natural Circulation Steam Generator Design of National 1000 MWe PWR,** H.P Cheng, Y.K. Xue, X.Y. Wang, G.Wu, M.X. Wang, J.L. Chen, H.Y. Liu, W. Wang, Ch. P. Zuo, H.T. Wu, RINPO
(not presented)

Session 5
Thermalhydraulics, Fouling and Cleaning
CONTINUED...

Co-Chairs: ***P.J. King, B&W Canada***
R.W. Staehle, U of Minnesota

#5-5 **Review of Steam Generator Chemical Cleaning Experiences From 1998-2002,** S. Evans, S. Watson, J. Remark, Framatome ANP and C. Hengge, First Energy Nuclear Operating Co.

#5-6 **Steam Generator Access Modification and Waterlance Cleaning for Wolsong and Other Nuclear Plants**
J. VandenBerg, P. Volder, P. Fleites, B&W Canada and B.-S. Han, KHNP

Session 6
Inspection Advancements and Experience and Fitness for Service

Co-Chairs: ***W. Schneider, B&W Canada***
J. Muscara, US NRC

#6-1 **Prediction of Failure Pressure and Leak Rate of Stress Corrosion Cracks,** S. Majumdar, K. Kasza, J.Y. Park and S. Bakhtiari, Argonne National Laboratory

#6-2 **Eddy-current Analysis Round Robin Using the NRC Steam Generator Mock-up,** D.S. Kupperman, Argonne National Laboratory, J. Muscara, US NRC, S. Bakhtiari, J.Y. Park and W.J. Shack, Argonne National Laboratory

#6-3 **Statistical Estimation of Flaw Size Measurement Errors for Steam Generator Inspection Tools,** T. Morrison, N.S. Mangat, Morrison Scientific Inc., L.B. Carroll, Fleet Technology Inc. and J. Riznic, CNSC

Session 6
Inspection Advancements and Experience and Fitness for Service continued...

Co-Chairs: ***W. Schneider, B&W Canada***
J. Muscara, US NRC

#6-4 **Technical Basis for the CANDU Steam Generator Tube Fitness-for-service Guidelines**, M.J. Kozluk, D.A. Scarth, Kinectrics Inc. and D.B. Graham, Ontario Power Generation

#6-5 **Wolsong 3 & 4 Steam Generator Tube Inspection,** K.-S. Jang, T.-B. Son, D.-K. Kwon, S.-B. Kim and Y.-Hee Lee, Korea Hydro and Nuclear Power Co Ltd.
(not presented)

#6-6 **Fast Single-pass Eddy Current Array Probe for Steam Generator Inspection,** L. Obrutsky, AECL, N. Watson, Ontario Power Generation, C. Fogal, R/D Tech, M. Cantin, Hydro-Québec, V. Cecco, R. Lakhan and S. Sullivan, R/D Tech

Session 7
Materials, Corrosion and Chemistry Control

Co-Chairs: ***A.M. Brennenstuhl, Kinectrics Inc.***
T. Cicerone, CNE-PROD Cernavoda

#7-1 **Assessment of and Proposal for a Mechanistic Interpretation of the SCC of High Nickel Alloys in Lead-containing Environments,** R.W. Staehle, U of Minnesota

#7-2 **Coupling Crevice Chemistry with a Corrosion Model in Laboratory: A First Application to the Analysis of Secondary Side Corrosion in Service,** E.M. Pavageau, F. Vaillant, S. Dimpre, M. Bouchacourt and L. Millet, EDF

#7-3 **Stress Corrosion Cracking Susceptibility of Alloy 800,** G. Ogundele, Kinectrics Inc., A. Manolescu, TEK 9 Solutions Consulting and M. Mirzai, Ontario Power Generation

#7-4 **Effect of Crevice Environment pH on Corrosion Damage of Horizontal Steam Generator Tubes**, A. Brozova, J. Burda and K. Splichal, NRI Rez

#7-5 **Influence of Temperature on the Fatigue Properties of Alloy 690,** G. Chai and J. Frodigh, AB Sandvik Steel